

Table G.38. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci)	Approximate Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approximate Peak Arrival Time (yrs)
1996-2007 Mixed LLW						
<i>200 East Area</i>						
C-14	0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00		
<i>200 West Area</i>						
C-14	7.52E-01	0.00E+00	>10,000	7.54E-01	0.00E+00	>10,000
Tc-99	9.63E-01	9.83E-03	1610	9.65E-01	9.85E-03	1610
Grouted Tc-99	3.34E+00	2.79E-04	1840	3.35E+00	2.79E-04	1840
I-129	1.81E-02	1.84E-04	1610	1.81E-02	1.85E-04	1610
Grouted I-129	0.00E+00			0.00E+00		
U-233	2.52E-03	0.00E+00	>10,000	2.53E-03	0.00E+00	>10,000
U-234	2.80E+00	0.00E+00	>10,000	2.81E+00	0.00E+00	>10,000
U-235	4.45E-02	0.00E+00	>10,000	4.46E-02	0.00E+00	>10,000
U-236	5.23E-02	0.00E+00	>10,000	5.24E-02	0.00E+00	>10,000
U-238	6.96E-01	0.00E+00	>10,000	6.97E-01	0.00E+00	>10,000

G.3 Use of ILAW Performance Assessment Calculations in HSW EIS Long-term Water Quality and Human Health Impacts

Impact results presented for the ILAW disposal facility were based on performance assessment (PA) calculations made for siting the facility in the vicinity of the PUREX Plant, as summarized in Mann et al. (2001). The following section discusses:

- Range of waste form and engineering performance examined to date, as discussed in Mann et al. (2001) including the specific discussion of the case selected for this analysis.
- Additional planned analyses of waste disposal system performance.
- Scaling of ILAW PA results for use in this analysis.

G.3.1 Range Of Waste Form and Engineering Performance Evaluated in 2001 ILAW PA

The long-term impacts from disposing ILAW was analyzed in the *Hanford Immobilized Low-Activity Waste Performance Assessment: 2001* (Mann et al. 2001), known as 2001 ILAW PA. A wide variety of cases were analyzed. Performance objectives covering air, groundwater, surface water, all-pathways, and inadvertent intrusion were established based on analyzing applicable and relevant regulations. The document concluded that there was a reasonable expectation that long-term public health and safety as well as the environment would be protected from the disposal in dirt trenches of a vitrified product from the Waste Treatment Plant (WTP). This document was reviewed by the Washington State Department of Ecology and approved by DOE headquarters, in accordance with DOE (2001).

The 2001 ILAW PA was built around a base analysis case. This case was designed to include the major features of disposal facility design and performance without going into details that have minimal impact in long-term performance. Important features are the waste composition and facility design.

At the time of writing the 2001 ILAW PA, the reference glasses to be produced by the WTP were not specified. Therefore, the ILAW PA activity used a glass composition (LAWABP1) developed by the Pacific Northwest National Laboratory in the composition envelope within which the WTP was working because of extensive laboratory testing data base for LAWABP1. Subsequent testing of the WTP reference glasses shows that the performance of LAWABP1 is very comparable to the WTP reference glasses. The results of the base analysis case, along with other cases analyzed, are illustrated in Figure G.90 as the curve labeled LAWABP1. Results of this case are also presented in tabular form in Table G.39.

The conceptual designs for the ILAW disposal facility have been evolving with time. The basic design is a set of large, deep trenches in the ground, underlain by plastic sheets. The presence of a surface barrier has remained constant while the width, depth, thickness, and placement of the trenches on the disposal site has changed. An important feature of the current conceptual design is a capillary break that acts as a moisture diverter underneath the surface barrier. As the name implies, this feature, using natural materials, diverts most of the water around and away from the waste forms. This case is labeled the best estimate case in the 2001 ILAW PA and is shown in Figure G.90 and summarized in Table G.39 as the “Enhanced Facility Design.”

Although a wide variety of sensitivity cases were run in the 2001 ILAW PA, the ones of most interest here are those addressing various waste form performance. The release of contaminants from a waste form can be quite complex, particularly for those waste forms containing large amounts of sodium waste (such as those containing tank waste). Cases were run to test the sensitivity of the results to models and data used. Cases were also run to determine the effect of various waste forms.

To determine the performance of a lower-quality glass, the 2001 ILAW PA investigated the behavior of HLP-31 glass. This glass releases contaminants at a rate of about 10 times faster than LAWABP1 and, moreover, does not exhibit the common trait of decreased release as the concentration of silic acid (a by-product of glass dissolution) increases. For the conditions expected in the ILAW disposal facility, these

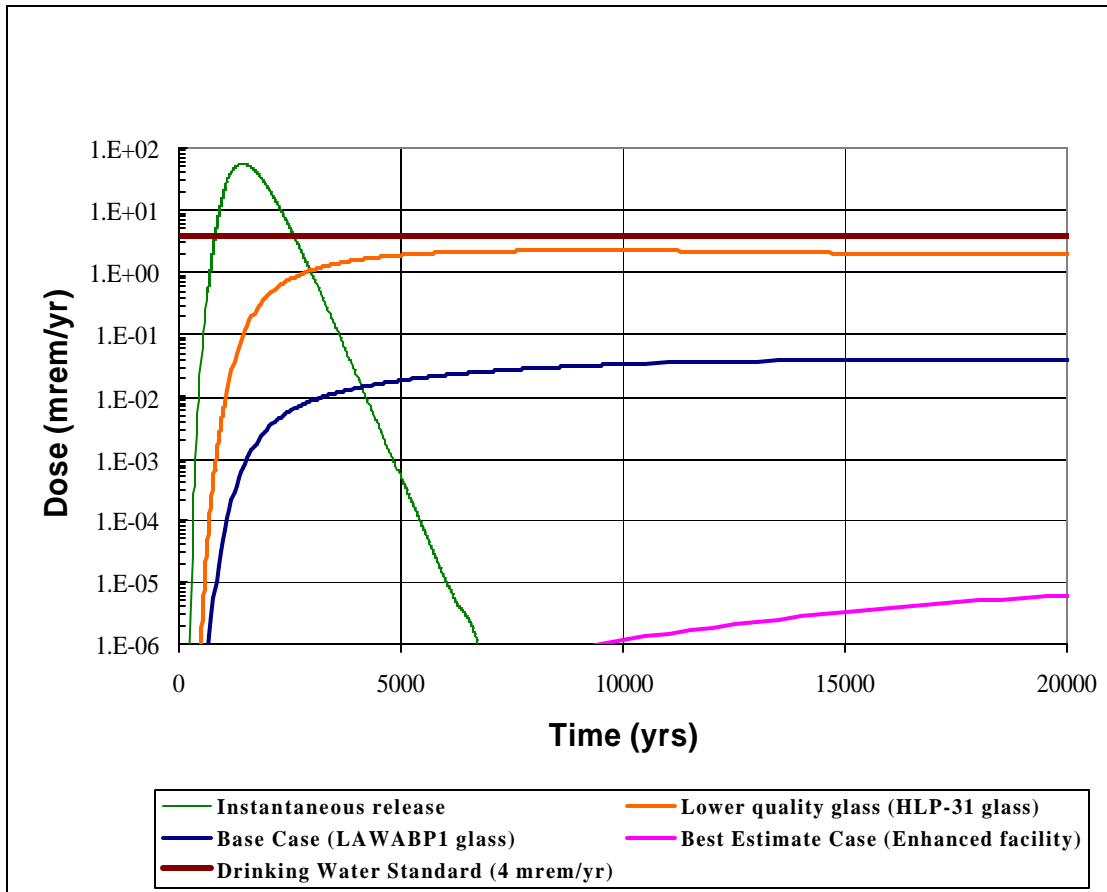


Figure G.90. Drinking Water Dose at a Well 100 Meters Down-Gradient from the ILAW Disposal Facility as a Function of Time for Various ILAW Waste Form Performance and Disposal Facility Parameters

two effects combine to cause the estimated impacts from HLP-31 waste forms to be about a factor of 100 greater than the impacts from the LAWABP1 waste forms. However, as seen from Figure G.90 and in Table G.39, even this higher release is estimated to be below 4 mrem/year, the level used by the U.S. Environmental Protection Agency for public water systems.

To investigate the performance of an extremely poor waste form, the 2001 ILAW PA investigated an extreme release case that assumed that all waste was released instantaneously. Because of the thickness of soil underlying the proposed ILAW disposal facility, the pulse broadens to the shape seen in Figure G.90 and summarized in Table G.39, which is actually quite broad (full width at one-tenth maximum of approximately 2000 years). For such cases, where the time over which release occurs is shorter than the time to travel through the soil to reach groundwater, the plateau-shaped curves of glass are replaced by peaked curves. The estimated drinking water dose for this instantaneous case is greater than 4 mrem/yr.

Table G.39. Drinking Water Doses (mrem/yr) Based on 2001 ILAW PA^(a)

Case	@ 1,000 years	@ 10,000 years	Peak (@)
Base Case (LAWABP1 glass) (b)	0.00007	0.034	.040 (98,000 yrs)
Best Estimate Case (Enhanced Facility Design) (c)	---	0.000001	Not calculated
Lower Quality Glass Case (HLP-31 glass)	0.006	2.2	2.3 (9,000)
Extreme Release Case (pulse)	19.7	---	56. (1,400)
(a) Renormalized for increased Tc-99, due to removal from Tc-99 separations process from WTP.			
(b) "Base analysis case" of the 2001 ILAW PA.			
(c) "Best estimate case" of 2001 ILAW PA.			

G.3.2 Additional Planned Analyses of Waste Disposal System Performance

The DOE has announced its plans for an environmental impact statement on the retrieval, treatment, and disposal of the waste being managed in the high-level waste tank farms at the Hanford Site and closure of the 149 single-shell tanks and associated facilities in the HLW tank farms (68 FR 1052). The HLW tanks contain both hazardous and radioactive waste (mixed waste). That document will provide additional analyses of low-activity waste treatment alternatives and disposal system performance.

G.3.3 Specific Scaling of ILAW PA Results for Use in the Analysis

G.3.3.1 Scaling for Estimated Inventory

Under a number of alternatives (Alternative Groups A, C, D₁, and E₃) where ILAW disposal is sited near the PUREX facility, results of a sensitivity case in Mann et al (2001) that analyzed the effect of 25,550 Ci of technetium was used. This case reflected no technetium removal in the separation processes from the Waste Treatment Plant. This technetium-99 inventory (25,550 Ci) is a factor of 4.4 higher than the estimated inventory of technetium-99 (about 5,790 Ci) if technetium-99 removal were considered in the separation process. The resulting scaled technetium-99 concentrations and other constituents from the ILAW PA that were used for those alternative groups where ILAW disposal is sited near the PUREX Plant is provided in Figure G.91.

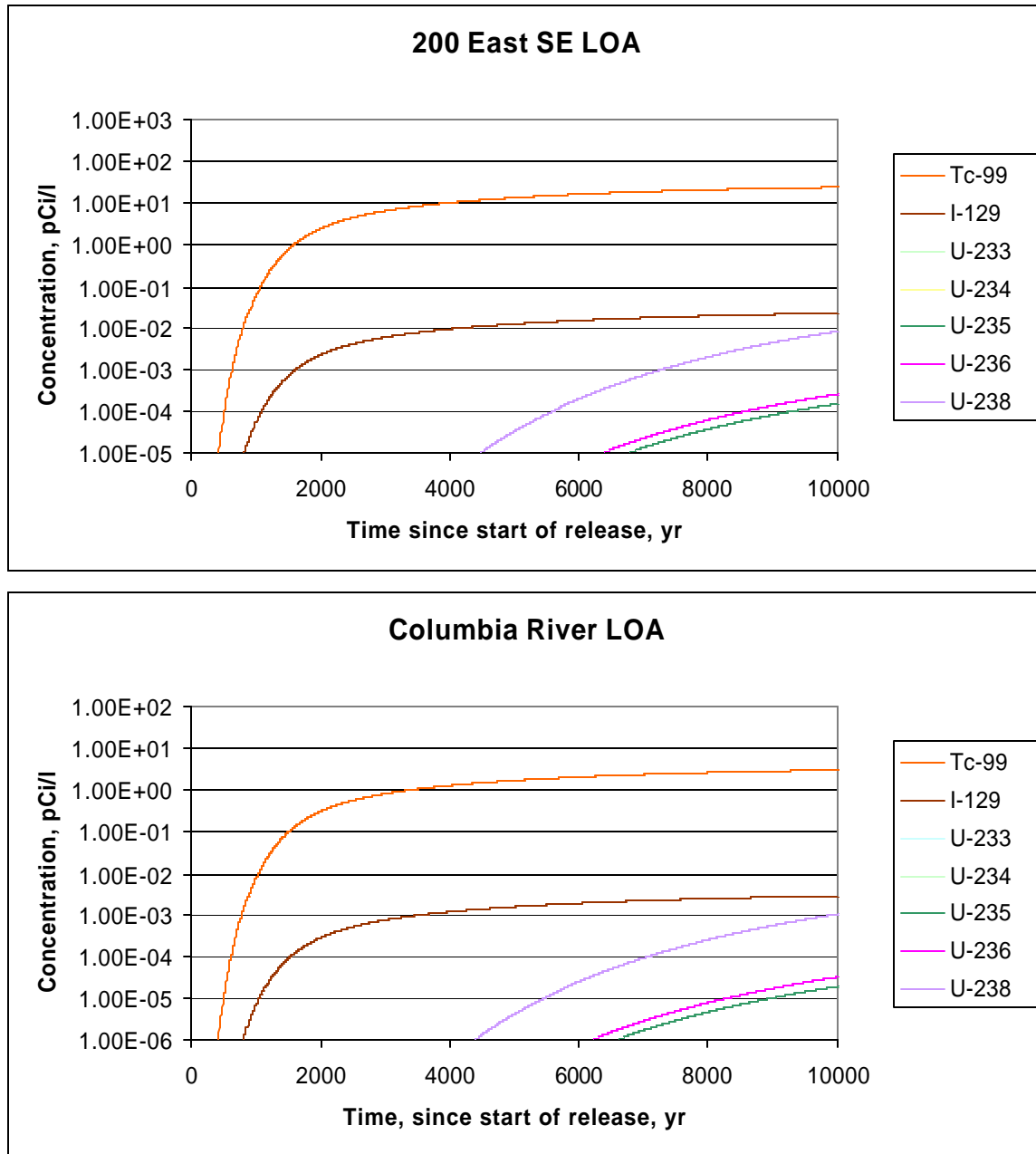


Figure G.91. Scaled Concentrations of Key Constituents that were Used from the ILAW PA at the 200 East Area SE and Columbia River LOAs for Those Alternative Groups where ILAW Disposal was Sited near the PUREX Plant, Alternative Groups A, C, D₁, and E₃

G.3.3.2 Scaling for Alternative HSW-EIS Disposal Site Locations

Impact results presented for the ILAW disposal facility were based on performance assessment calculations made for siting the facility in the vicinity of the PUREX Plant, as summarized in DOE/ORP (2001). However, for a few of the alternative groups, the ILAW disposal facility is sited in areas south of the CWC and at ERDF, and the calculated impacts at these alternative sites would be expected to be different because of the change in hydrogeologic conditions and hydraulic properties at these three locations.

For purposes of this analysis, the human health impacts results presented in Appendix F and Section 5.11 for Alternative Group A (where the ILAW disposal facility is sited in an area south of the CWC) and Alternative Groups D₃, E₁, and E₂ (where the ILAW disposal facility is sited in the ERDF area) are based on simple scaling of comparative simulation results of source releases in these areas using the sitewide groundwater flow and transport model. Groundwater concentrations and results of human health impacts summarized in the original performance assessment calculations described in Mann et al. (2002) were based on well intercept factors (WIFs) or dilution factors from a given areal flux of a hypothetical contaminant released to the unconfined aquifer from the ILAW disposal facility (Bergeron and Wurstner 2000). The WIF is defined as the ratio of the concentration at a well location in the aquifer to the concentration of infiltrating water entering the aquifer. These WIFs are being used in conjunction with calculations of released contaminant fluxes through the vadose zone to estimate potential impacts from radiological and hazardous chemical contaminants within the ILAW disposal facility at LOAs.

For the purposes of implementing the limit release calculation, the concentration of a source entering the aquifer of 1 Ci/m³ was used. The rate of mass flux associated with this concentration is a function of the infiltration rate assumed for the disposal facility covered by the modified RCRA Subtitle C cover system. With a rate of 0.42 cm/yr assumed for the ILAW disposal facility, the resulting solute flux entering the aquifer from each of the disposal concepts is 4.2×10^{-3} Ci/yr/m². This is the product of the contaminant concentration in the infiltrating water and the infiltration rate.

In the simulations used to support this assessment, the same calculation performed for the base case described in Bergeron and Wurstner (2000) (see Section 6.1.1) using the regional scale model was performed again at the approximate PUREX location and the two alternative areas described in Alternative Group A (south of the CWC) and Alternative Groups D₃, E₁, and E₂ (near ERDF) using the groundwater models in this assessment. The ratio of predicted WIFs at the 1-km (0.6-mi) LOA and along the Columbia River down-gradient from the CWC and ERDF locations to the comparable predicted WIFs from the PUREX locations provided the basis for the scaling of results used in this analysis.

The groundwater model using the extended basalt subcrop conditions north of the 200 East Area and the resultant predominant easterly flow out of the 200 East and West Areas was considered to be most representative of original conditions simulated with the model used by Bergeron and Wurstner (2000) of the two groundwater evaluations in this analysis. This model was the one used in this comparative analysis.

Results of WIFs using an assumed infiltration rate in the source area of 0.42 cm/yr for the three postulated ILAW disposal locations, presented in Figure G.91, suggest that predicted groundwater concentrations and calculated human health impacts would be a factor of about 3 higher and about 3.4 higher at the 1-km (0.6-mi) LOA down-gradient of the HSW disposal site locations (south of CWC and near ERDF, respectively) relative to a comparable location down-gradient from the PUREX location. These higher-predicted concentrations would be consistent with differences in hydrogeology at these two locations relative to conditions found near the PUREX Plant. Near the PUREX Plant, the upper part of the unconfined aquifer is largely composed of very permeable sediments associated with the Hanford formation. Whereas, at the ERDF and CWC locations, the upper part of the unconfined aquifer is made up of less permeable sand and gravel sediments associated with the Ringold sediments.

Results of WIF ratios at LOAs along the Columbia River resulting from releases at these two alternative locations are also presented in Table G.40. The resulting WIF ratio suggests that peak concentrations estimated along the Columbia River from these alternative locations of disposal would have about a factor of 0.8 and 0.9 lower, respectively, than was calculated from releases near the PUREX Plant. The reduction in concentration levels would be consistent with the longer flow path to the Columbia River location.

Table G.40. Well Intercept Factors at Down-Gradient LOAs from the ILAW Disposal Facility Sited near the PUREX Plant and Alternative Locations (South of the CWC under Alternative Group A and near ERDF under Alternative Groups D₃, E₁, and E₂)

	Near PUREX	South of CWC	Near ERDF
1-km LOA			
WIF	5.1E-04	1.5E-03	1.8E-03
Ratio to WIF to WIF (near PUREX)	1.0	3.0	3.4
Columbia River LOA			
WIF	1.8E-04	1.4E-04	1.6E-04
Ratio to WIF to WIF (near PUREX)	1.0	0.8	0.9

G.4 References

- Bergeron, M. P. and S. K. Wurstner. 2000. *Groundwater Transport Calculations Supporting the Immobilized Low-Activity Waste Disposal Facility Performance Assessment* PNNL-13400, Pacific Northwest National Laboratory, Richland, Washington.
- Bryce, R., C.T. Kincaid, P.W. Eslinger, L.F. Morasch. 2002. *An Initial Assessment of Hanford Impacts Performed with the System Assessment Capability*. PNNL-13027, Pacific Northwest National Laboratory, Richland, Washington.